tractility. Nine patients with mild or moderate mitral regurgitation (MR) and resting LV ejection fraction (EF) 14 to 70% (41.7 ± 22.2) underwent quantitative DTI of the inferoposterior mid-myocardium. LV dP/dt was estimated from the rate of change of MR velocity on continuous wave Doppler. LV EF, dP/dt and DTI peak systolic velocity (Vel) were measured both at rest and during dobutamine (Dobut) infusion (range 30 to 50 mcg/kg/min, mean 34 ± 7), and evaluated for change (Δ) from baseline:

	Rest	Dobut	Δ	p
EF (%)	41.7 ± 22.2	56.6 ± 27.9	14.9 ± 8.3	0.001
DTI Vel (mm/s)	22.7 ± 4.2	35.3 ± 10.1	12.6 ± 8.7	0.004
dP/dt (mmHg/ms)	1050 ± 322	1766 ± 768	716 ± 622	0.01

Direct relationships existed between LV dP/dt and both EF ($R = 0.78$, $p = 0.004$) and DTI Vel ($R = 0.81$, $p = 0.002$). The change in dP/dt during dobutamine infusion compared to baseline exhibited a stronger correlation with change in DTI velocity ($R = 0.77$) than with change in ejection fraction ($R = 0.35$).

We conclude that 1) both EF and peak systolic myocardial velocity are directly related to LV contractility measured by dP/dt, and 2) catecholamine-induced alteration in myocardial contractility is better reflected by changes in myocardial velocity than by changes in EF. Measurement of myocardial velocity using quantitative DTI may be useful in the noninvasive assessment of ventricular contractility, and may be a useful adjunct to echocardiographic wall motion analysis during catecholamine stress testing.

906-64 Doppler Tissue Imaging of Left Ventricular Myocardium — Initial Results During Pharmacologic Stress

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The new technique of Doppler tissue imaging (DTI) theoretically has the potential to quantify regional myocardial function. To determine the pattern of normal and ischemic LV contraction and relaxation during pharmacologic stress we studied DTI during a Dobutamin stress test (incremental steps from 5 up to 40 mcg/kg/min per 5′) in 18 patients with suspected ischemic heart disease using coronary angiography (CA) and conventional stress echocardiography (SE) for reference. We used a conventional ultrasound equipment (Acuson 128 XP) with software modifications which allowed also the display of myocardial regional velocities by colour Doppler (CD) and by the pulsed Doppler mode. Velocity patterns were analyzed in representative regions for each vascular bed as for peak velocities of contraction (V_C) and relaxation (V_R) and were compared to the echocardiographic score index in a 14 segment model.

DTI images in CD and pulsed wave Doppler could be obtained in all patients. The analysis of 2-dimensional CD images gave similar morphological regional information as SE. Analysis, however, proved difficult in the presence of high heart rates due to low frame rates. In the 7 patients without coronary artery disease, there was a significant increase of V_C (9.3 ± 4.1 to 13.1 ± 5.3 cm/s) and V_R (−10.4 ± 2.6 to −14.8 ± 4.2 cm/s) during peak stress ($p < 0.01$). In infarcted beds, V_C and V_R were low both before and during peak stress. In regions supplied by an artery with <50% stenosis, V_R more than V_C decreased during peak stress. Sensitivity for the diagnosis of coronary artery disease was 81% using SE and 92% using DTI.

In conclusion: DTI provides quantification of regional LV contraction and relaxation and thus augments ultrasound stress studies.

906-65 Use of Color-coded Tissue Doppler for Dobutamine-Stress-Echocardiography

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In order to improve analysis of regional wall motion color-coded tissue Doppler-echocardiography (TDE) 14 dobutamine-stress-echocardiograms (DSE) (5–40 μg/kg/min) were performed to detect left ventricular myocardial tissue and to measure left ventricular myocardial velocity (WMV) during contractile stimulation. The patients (pts) were divided into 11 with known 2–3 vessel coronary artery disease (CAD) including LAD-stenosis and a normal group (N) of 3 without CAD. At phases rest (R), low dose (LD = 10 μg/kg/min) and peak exercise (PE) we registered with TDE a 2-dimensional echo at RAO-view and at parasternal long axis with a M-mode registration, respectively. Measurements of myocardial velocities were performed by placing a point of interest in the middle part of each AHA-segment in each frame covering one heart cycle (frame rate = 26–36/s).

Results: The mean WMV in the N group increased during low-dose dobutamine infusion from 43 ± 11 to 49 ± 11 mm/s and during high dose infusion to 58 ± 17 mm/s, whereas in the CAD-group the mean WMV were 31 ± 12 (R), 33 ± 11 (LD) and 37 ± 15 mm/s (PE) respectively. In pts with CAD during dobutamine-infusion the beginning of systolic contraction detected by TDE-M-Mode-registration was delayed in comparison to normal subjects.

Conclusion: Detection of exercise-induced decrease of myocardial velocity by combination of color-coded tissue Doppler-echocardiography and dobutamine-stress-echocardiography is a new valuable method for detection of regional impairment of left ventricular wall function.

906-66 Quantitative Analysis of Left Ventricular Wall Motion Abnormality Using Real-time 2-Dimensional Echocardiographic Motion Imaging System

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Although automated border detection techniques permitted real-time measurement of cavity area throughout the cardiac cycle, evaluation of LV regional wall motion have been semi-quantitatively based upon visual findings. A newly developed 2-D echo motion imaging system with 3.5 MHz transducer stores an endocardial edge echo and real-time track image of LV motion is visualized as a white zone. Excursion and direction of LV wall motion were identified as width and gradual brightness from dark to bright on 2-D echo image, respectively. In 20 patients with myocardial infarction and 9 normals, real-time motion images on parasternal and apical long-axis 2-D echo were recorded on video tape. Wall excursion were measured at 61 sites including interventricular septum (IVS) and LV infero-posterior wall (PW). Conventional optimal 4-graded classification of LV wall motion (Normo, Hypo, A, and Dyskinesis) was simultaneously performed by two individual observers. Excursions of IVS were 8.2 (4.9–14.0) mm at 15 Normo sites and 4.0 (2.8–4.8) mm at 8 Hypo sites, and those of PW were 8.3 (4.7–15.0) mm at 21 Normo sites and 4.1 (2.8–5.3) mm at 5 Hypo sites, and less than 2.1 mm at 9 akinetic sites. 3 dyskinetic segments were depicted as conversed graduate zone in brightness and clearly distinguish from others. Thus, real-time 2-dimensional echocardiographic motion imaging system provides objective and quantitative estimation of LV wall motion on 2-D echo.

906-67 Is Mitral Annulus Motion During Early Diastole Active or Passive? Clinical Evidence of Elastic Recoil

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It has been postulated that elastic recoil plays an important role in LV filling and its absence or reduction contributes to diastolic dysfunction. Early diastolic motion of the mitral annulus is related to LV recoil. We hypothesized that if elastic recoil promotes LV filling then peak annular velocity should precede peak mitral filling and that diastolic dysfunction would alter this relationship. In order to elucidate this issue we studied the motion of the mitral annulus using Doppler Tissue Imaging (DTI) and compared it with Pulsed Doppler of the mitral inflow in 10 patients with diastolic dysfunction (Group 1) and 10 age-matched controls (Group 2). *Methods:* Group 1 comprised patients with LVH n = 8 and cardiomyopathy n = 2. Mean age was 57 ± 15 years. All were in sinus rhythm. Mitral inflow pulsed Doppler and DTI mitral annular velocities were recorded from the apical 4ch view using an ultrasound machine with DTI capabilities. The following measurements were obtained: peak early diastolic annular velocity (E_a), peak E wave of mitral inflow (E_m), time difference between the onset of annular motion and onset of mitral flow (Δo) and time difference between peak E_a, and peak E_m (Δ_{peak}). *Results:*

	Peak E_a	peak E_m	Δo	Δ_{peak}
Group 1	7.3 ± 2 cm/s	94 ± 30 cm/s	−1.5 ± 12 msec	7.5 ± 19 msec
Group 2	11.3 ± 3 cm/s	61 ± 18 cm/s	−1 ± 15 msec	−22 ± 15 msec
p	0.009	0.01	ns	0.002

Conclusion: 1) In patients with diastolic dysfunction the peak early velocity of annular motion is lower despite higher mitral filling velocities. 2) In normals, the peak velocity of annular motion precedes peak mitral filling. This is reversed in patients with abnormal diastolic function. 3) These data suggest that LV recoil contributes significantly to normal early LV filling.